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Reuse Status of Uncontrolled Hazardous Waste Sites after Remediation in Europe and the United States

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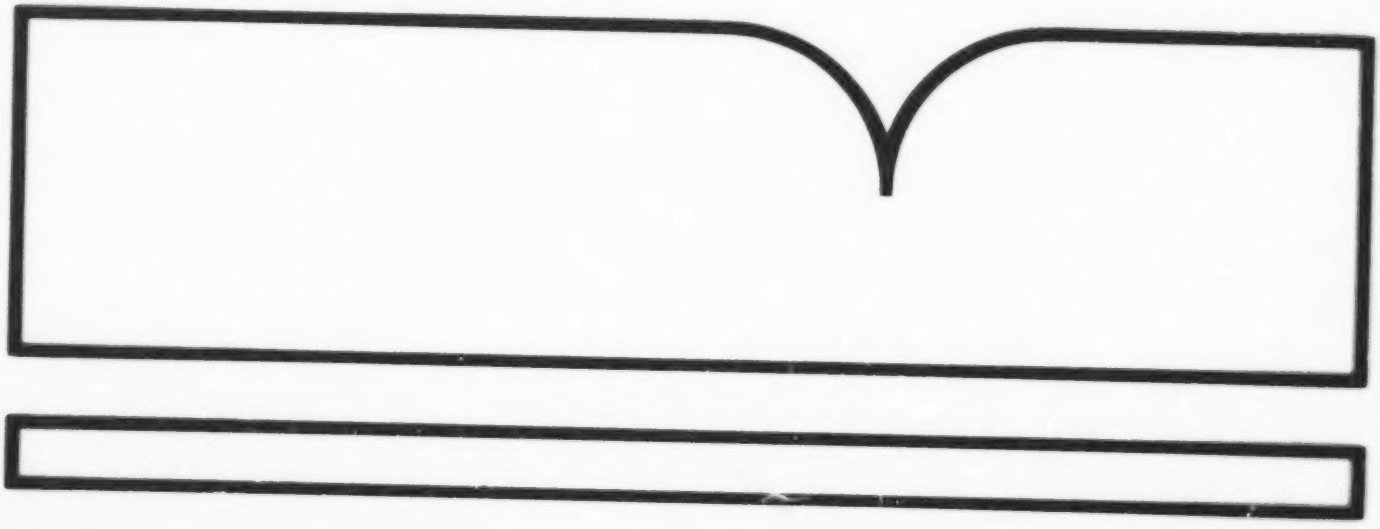

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REUSE STATUS OF UNCONTROLLED HAZARDOUS WASTE SITES AFTER REMEDIATION IN EUROPE AND THE UNITED STATES

by

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Case studies for nineteen hazardous waste sites in several European countries and twelve sites located in the U.S. were selected and examined in detail. These study sites included former coal gasification sites, fertilizer and pesticide manufacturing sites, defense manufacturers and several uncontrolled dump sites. Land reuse focused largely on residential and industrial concerns, but also consisted of governmental, commercial and agricultural facilities.

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1. ABSTRACT

Reclamation and redevelopment of contaminated properties in the United States (U.S.) and Europe have been addressed by analyzing what has and is being done at the present time.

The U.S. Environmental Protection Agency (USEPA) initiated an effort in 1983 which substantially documented the U.S. experience. In 1985 attention was given to the European experience in the area of reclamation and reuse of the land.

Case studies for nineteen hazardous waste sites in several European countries and twelve sites located in the U.S. were selected and examined in detail. These study sites included former coal gasification sites, fertilizer and pesticide manufacturing sites, defense manufacturers and several uncontrolled dump sites. Land reuse focused largely on residential and industrial concerns, but also consisted of governmental, commercial and agricultural facilities.

2. INTRODUCTION

Uncontrolled hazardous waste sites in the U.S. and Europe occur in various geological settings and in urban as well as rural areas. These sites may be operational, inactive or abandoned. Due to the wide range of chemical wastes deposited at these sites, the extent and severity of environmental contamination varies greatly.

The extent of remedial action required to protect the public health and welfare is influenced by numerous factors, many of which are site-specific. Some of the important factors are climatic or hydrogeological in nature. Others relate to land surface features such as topography or developments that determine exposure routes. The types of chemicals present on-site, the potential for migration, the degree of contamination, the extent of the area affected, and the costs of remedial action alternatives are all issues. Other important issues include the relationship to drinking water sources and population centers, social and economic impacts, and the potential for land redevelopment and reuse.

As part of each hazardous waste action, an assessment must be made of the contamination at the site. The

options for remedial action to remove or otherwise deal with hazardous materials will depend on the nature of the contamination and other site-specific factors and on the level of contamination that will be allowed to remain on-site following clean-up. Thus, a need arises in planning site remediation for criteria to define acceptable levels of pollutants.

Acceptable concentrations of most toxic substances protect public health and welfare have not been determined. In most cases, scientific criteria for cleanliness levels do not exist. In the United States only California has developed criteria to explicitly define hazardous waste. The guidelines contained in the Draft California Assessment Manual, referred to as the CAM Standards, were adopted as formal definitions of "hazardous" and "extremely hazardous" wastes, for that state.

3. BACKGROUND AND PURPOSE

In the U.S., prior to 1976, few states had regulatory programs for land disposal of hazardous wastes. National awareness of hazardous waste problems increased in the mid 1970's as it became evident that indiscriminant dumping of hazardous wastes at many sites had led to the release of toxic materials into the land, water, and air.

The U.S. Congress responded to the national concern over hazardous wastes by enacting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) better known as Superfund. RCRA is concerned primarily with the proper management and permitting of present and future controlled hazardous waste containment areas. Superfund activities focus on potential hazards posed by uncontrolled hazardous waste sites.

The reuse of uncontrolled hazardous waste sites after remedial measures have been implemented is an area that has not been previously investigated or studied in any detail. As the number of known uncontrolled hazardous waste sites increase, so will the necessity and desire to implement remedial action that will establish a site valuable for future reuse.

After documenting hazardous waste site reuse in the United States, where uncontrolled hazardous waste sites had been cleaned up according to a plan that included details on the nature of contamination and cleanup procedures, attention was given to studying how other countries have addressed this situation. Countries included in Part II of this study were England, The Netherlands, Sweden, Wales and West Germany. Information gathering

in both Europe and the U.S. required field inspections at the sites where remediation had been undertaken.

The purpose of the study is to develop a data base for regulatory officials to begin to formulate policy regarding land reuse after remediation of hazardous waste sites. Case studies of reuse of land after cleanup provide a beginning for officials concerned with this issue that will become more urgent in the future.

4. CASE STUDIES

Redevelopment is not currently planned for the majority of uncontrolled hazardous waste sites in the U.S., however, some formerly contaminated sites have been redeveloped. Lack of availability of English translations of documentation of some European sites has decreased the amount of data that can be reported at this time.

Four United States and four European Sites are described here. Brief descriptions of additional case studies are provided in Tables 1 and 2.

4.1 Miami Drum Services Site, Miami, Florida (MDS)

4.1.1 Land Use History and Redevelopment. The Miami Drum Services facility operated for 15 years as a chemical drum recycling center until June 1981 when it was closed by court order. It was purchased by Dade County as the location for a maintenance facility for the Metro Dade County Transportation Administration's rapid transit system. Today the land is covered with rails and is used as a storage yard for commuter rail vehicles in need of repair.

4.1.2 Nature of contamination. MDS handled thousands of drums of various wastes, including corrosives, solvents, phenols, and toxic metals. Drums were washed with caustic cleaning solutions. These solutions along with drum residues of solvents, acids and heavy metals, were then disposed onsite. Spills from these drums contaminated surface soils and groundwater.

Soil samples collected from a maximum depth of 3 meters indicated high concentrations of phenols, heavy metals, oil and grease, and pesticides. Groundwater samples also showed the same contaminants.

4.1.3 Criteria for Cleanup. Soils with levels ten times "minimum criteria" for groundwater were removed. These criteria are listed in Table 3. Highly colored, oily soils were removed. Areas that received runoff from drum-washing were excavated.

4.1.4 Remediation activities. Soil excavation and off-site disposal was determined to be the best method of remediation. A total of 7,335 cubic meters of hazardous debris and contaminated soil was excavated and removed from the MDS site. Contaminated ground water was treated

on-site.

4.2 Bolsa Chica Site, Huntington Beach, CA

4.2.1 Land use history and redevelopment. Starting in the 1930's, refinery sludges were dumped at the site without a permit. Uncontrolled dumping of industrial waste and drilling mud also occurred. In 1963, the site was authorized as a landfill restricting disposal to inert solid waste material.

In 1979, the California Department of Health Services (CDHS) located pools of toxic materials and a leachate plume extending 61 meters. Despite these findings, a development company indicated a willingness to pay the costs to clean up the site for building as condominiums. Since cleanup was completed in 1981, 288 condominium-style residential units have been constructed at the site.

4.2.2 Nature of contamination. Three types of materials were discovered. Some soil contained mostly aliphatic hydrocarbons with some phthalates and other priority pollutants. Below this was a second type of soil which, in addition to the aliphatic hydrocarbons, contained a significant level of thiophene-type compounds plus some aromatic amines similar to quinoline. A third type of material found ponded at the surface had a large quantity of hydrocarbons and aromatic compounds. The site was also known to give off methane gas.

4.2.3 Criteria for cleanup. The California Assessment Manual (CAM) standards combined with evidence of potential hazard due to toxicity, explosivity, and odors were used as criteria to guide the site cleanup. All material with pH of less than 2.0 was removed.

The extent of the excavation and removal of the material judged to be hazardous was based on extensive chemical analyses of wastes and soil. Samples were taken from 20 boreholes drilled at strategic locations on the site. Solid/sludge samples were analyzed for aliphatic hydrocarbons, aromatic hydrocarbons, chlorinated organics, heavy metals, and PCB's. Well vapor samples were analyzed for aliphatic and aromatic hydrocarbons, chlorinated organics, organic lead, mercury, selenium, organic sulfur, and hydrogen sulfide.

4.2.4 Remediation Activities. After reviewing several options, cognizant agencies agreed that complete removal of the hazardous materials on-site with disposal at a suitable landfill would be the most feasible and acceptable method of mitigating long term groundwater, vapor, and soils impacts.

4.3 Chemicals Metals Industries, Inc., Baltimore, Maryland

4.3.1 Land use history and redevelopment. Chemical Metals Industries, Inc., recovered precious metals from waste chemical solutions and printed circuit boards. This site consisted of two areas, a storage garage and yard,

and a manufacturing center. Both areas were remediated using Superfund resources. Area 1 is now a neighborhood park and area 2 is being utilized as office and storage space for the Maryland Department of Health.

4.3.2 Nature of contamination. Area 1 contained 1500 deteriorated plastic and metal drums. Liquids leaked into the ground. The drums contained corrosive liquids, cyanide-bearing compounds, ammonia-bearing compounds and organic solvents. Waste oil and gasoline were located in leaking underground storage tanks.

Area 2 contained 15 processing, chemical and waste storage tanks filled with varying amounts of liquid and crystalline materials and drums filled with acids, caustics, salts, and wastes. Sampling confirmed the presence of cyanide and ammonia-bearing materials and corrosive liquids.

4.3.3 Criteria for cleanup. The initial criteria for cleanup involved the identification and removal of chemically incompatible materials and unstable materials from the site. Later cleanup operations were aimed at eliminating all potential chemical and physical hazards. Thorough cleanup measures were deemed to be necessary due to its location in a residential neighborhood.

Soil removal at the site was guided by the RCRA EPA Toxicity characteristics defining hazardous waste. Soils were determined to be hazardous and were removed if levels of metals in the extract from the test exceeded the established criteria of 100 times drinking water standards.

4.3.4 Remediation activities. Liquids were pumped from the underground tanks at area 1. After emptying, these tanks were filled with a concrete slurry. Walls of the existing structure on Area 1 were decontaminated by sandblasting. Contaminated soil and other debris was removed to a permitted disposal facility. After removal of all hazardous materials and other debris, the site was graded, capped and sodded.

At Area 2, acidic and basic/neutral solutions were pumped from the above-ground storage and processing tanks, and removed from the site. Drums of acids, caustics, salts, and other unidentified wastes were removed from the site to a permitted disposal facility. The yard was paved following cleanup and surface grading.

4.4 Homart Development, South San Francisco, CA

4.4.1 Land use history and redevelopment. The Homart site was formerly the site of a steel mill and fabrication plant operated by Bethlehem Steel. The plant, operated from 1903 to 1977, used coal-fired open hearth furnaces. During the 1960's the only activity at the plant was a steel galvanizing operation. A wire and netting manufacturing facility occupied one portion of the site, where steel wire was drawn and galvanized.

The site was purchased in 1977 by the Homart Development Company to be redeveloped as a combination hotel/

commercial/office park development. A twelve story building has been erected and all substructure, including connecting roads, is now in place. The development is scheduled to be completed in 1987.

4.4.2 Nature of contamination. Twelve subareas of the site were identified for investigation of the extent and nature of the contamination. Pollutants identified in samples taken were PCB's, oil, chromium, copper, manganese nickel, lead, zinc, cadimum and acid wastes. PCB contaminated oil was found in the soil and fractured bedrock underlying the oil storage area.

4.4.3 Criteria for cleanup. The Draft California Assessment manual for hazardous wastes was the guideline document used to establish the concentrations at which specific toxic substances would be assessed as hazardous. PCB's in soil and oil that exceeded these standards were removed from the site.

4.4.4 Remediation activities. Remediation contained the majority of contaminated materials on-site, due to the large volumes involved. Placement of the materials was determined by the groundwater contamination threat perceived for different subareas of the site. The plan called for relocation of contaminated soils to the south end of the site. Other hazardous materials were moved to off-site disposal facilities.

The remediation agreement stipulated that the location of the soils be clearly designated on a site map and that these areas not be excavated or substantially disturbed in the future. A restrictive covenant effective into perpetuity was placed on the deed to the property. The deed restriction, which transfers to all future owners, limits the site to commercial, light industrial, office park and hotel uses. The 30.5-cm cover must be maintained.

4.5 Corby Steelworks, Corby, England

4.5.1 Land use history and redevelopment. Corby is the site of a former British Steel Corp. steel mill. During the 1930's, integrated iron, steel, and tube works were developed. All but the tube mill portion of the steel mill was closed in 1979.

Corby can be divided into several areas according to site history and reuse objectives. Reuse plans for each of the areas focus on light and heavy industrial uses.

4.5.2 Nature of contamination. Due to a variety of previous uses of the different areas, different types and levels of contaminants were found at each site. The contaminants found at the site of the steel plant include: heavy metals, tar, polycyclic aromatic hydrocarbons, and oily wastes. No significnt groundwater contamination was found.

The slurry deposit area had a high level of cyanides, sulfur salts, and heavy metals, mostly within the top 1.0 m of ground. The coking operations region was heavily

contaminated with cyanide and organic compounds. Heavy metals and sulfur salts were also found. Most of the contamination was located in the upper .75 m of ground.

4.5.3 Remedial activities. Remediation efforts at the plant involved recycling scrap material left on-site. The most heavily contaminated land was excavated and deposited on site in former slurry lagoons. These areas were then overlaid with .5 to.75 m of a boulder clay cover. Foundations of former buildings were removed and filled with clean material.

Remediation of the site of the former by-products plant involved excavation of .75 million cubic meters of buried slurry, repositioning of fill material, drainage and landscaping. The scale of the cleanup undertaken depended on the nature and extent of the substances found in each area.

4.6 Augustendal Dumpsite, Nacka, Sweden

4.6.1 Land use history and redevelopment. The Augustendal area dumpsite was used mostly for the disposal of household waste, but demolition and building waste and hazardous waste was also deposited at the site. The dump itself is in a valley three to seven meters deep. In the late 60's, the community decided to use the land for housing. Plans for development calls for the construction of 1100 apartments, and school buildings.

4.6.2 Nature of contamination. Analysis of the soil showed a neutral to alkaline pH and an elevated level of corrosivity. Mercury and lead were found in some samples. Water at the site showed elevated corrosivity but normal metal content. Groundwater contamination was not a major concern at the site because the groundwater does not serve as a drinking water source.

4.6.3 Remediation activities. The material at the site was excavated and separated according to content. The debris was also screened and sorted by size. Municipal and industrial wastes were separated from demolition wastes. Samples were taken, and non-toxic soil was deposited at the other end of the valley as fill. This amounted to about one-quarter to one-third of the soil excavated. The remaining contaminanted soil was transported to a licensed disposal facility. During the excavation, water downstream from the site was monitored for contamination.

4.7 Wandworth Gas Works, London, England

4.7.1 Land use history and redevelopment. The Wandworth Gas Works was involved in the production of coal gas. By-products of gasification were discarded at the site, contributing to the soil pollution. These by-products include spent iron oxide, which was simply spread over the site. The Greater London Council purchased the site, with plans to develop light industry.

4.7.2 Nature of contamination. Investigations in both 1976 and 1980 found the site to be very highly polluted with a variety of contaminants. Samples taken showed contamination with non-metallic pollutants, such as coal tar, phenol, sulfur derivatives, and cyanides. Methane was also detected in a few of the test boreholes drilled.

4.7.3 Remediation activities. Because excavation of the area might result in mixing of contaminants and the release of toxic gases such as hydrogen sulfide and hydrogen cyanide, redevelopment activities involving extensive disturbances of the surface were not undertaken. The most contaminated soil was excavated and deposited in a hazardous waste landfill off-site. Foundations from the gas works structures were left in place.

4.8 Tilburg Gas Works, Tilburg, The Netherlands

4.8.1 Land use history and redevelopment. In the late nineteenth century, a gas works site was established in what is now central Tilburg. Coal gas was produced for more than 100 years. Tar and coke, were produced. Benzene, napthalene, and ammonia, were removed and purified. Sulfur and cyanide compounds were obtained.

The gas works site will be reused for multi-family dwellings, private homes, and parking lots.

4.8.2 Nature of contamination. Investigation for pollutants at the site found the soil contained cyanides, heavy tar, oil, heavy metals, and polycyclic aromatic hydrocarbons.

Twenty-two observation wells were used to obtain groundwater samples. The groundwater was contaminated with benzene.

4.8.3 Remediation activities. Remediation activities involved excavation of the soil to a depth of 4 to 6 m. Removal of some structures and a parking lot was required, before soil excavation. Several deep wells were constructed to lower the water level at the site. A trial purification of the contaminated water showed that the local treatment facilities were adequate to clean the water.

5. RESULTS AND CONCLUSIONS

5.1 Results.

The results of this study in both Europe and the U.S. emphasized the value of land reuse planning in the design of site remediation efforts.

In the U.S. case study sites include former Department of Defense properties, defunct gasification sites, abandoned chemical recovery and drum recycling facilities, a former steel mill, munitions, fertilizer, and pesticide manufacturing sites, a coal tar refinery, a warehouse for chemical storage, and several uncontrolled dump sites. Land reuses at these sites include industrial parks, recreation parks, a hotel and convention complex,

single family residences, a public school, residential condominiums, a housing complex for handicapped and elderly, a neighborhood playground, and State offices and facilities.

Six of the land reuse case studies are located in California. Concerns at these sites pertained mainly to potential exposure of persons who might live or work at the site following redevelopment. In most cases, soil and other material that were determined by the California Department of Health Services to be hazardous were removed to a permitted disposal facility. All of the California case studies are located near large metropolitan areas.

At many of the European sites hazardous contamination arose from gas works facilities prevalent in industrialized countries until the middle of this century when natural gas replaced coal gas. The tar, sulfur, cyanide and aromatic substances produced at such gas works contributed to the contamination of at least nine of the European sites. Excavation and disposal, either on-site or off-site, at licensed landfills is the most often utilized method for remediation. In situ treatment was the disposal technology of choice for only one site.

Reuse of the various European sites was largely for residential and industrial use.

In both Europe and the U.S. uncontrolled waste site development projects appear to be of two distinctly different types. The first type may be termed the developer-initiated redevelopment effort. Such cases of site cleanup and redevelopment occur where the advantages of a site location alone are so great that cleanup costs can be recovered through future resale of the remediated property. In such cases, the decision to remediate and redevelop a specific site is made in the private sector, and the public sector simply regulates and certifies the cleanup process.

The second type of hazardous waste site redevelopment project is the public-initiated project where reuse of the land is clearly secondary in importance to the site remediation that is required for public health and safety. This appears to be the case, for example, with almost all Superfund sites. For most public-initiated cleanup operations, remediation activities are so complicated and costly that the economic value of the site following cleanup only partially (if at all) justifies the cleanup operation.

5.2 Conclusions

In the U.S. very few of the sites examined for reuse status involved Superfund sites. Reuse is not yet a part of the cleanup planning.

California leads other States in the formulation and enactment of legislation and regulations pertaining to the cleanup and redevelopment of contaminated properties. With adoption of the CAM Standards, California

has begun to define quantitatively what is meant by "hazardous waste contamination."

Governments in Europe appear to provide funding for most of the case studies presented. Reclamation of contaminated land in Europe is often part of a broader government economic or social program. Creation of jobs for local populations can be an incentive for cleanup and reuse of hazardous waste sites.

Lack of adequate, cost effective disposal technology is a problem. On-site disposal is preferred to off-site disposal. Off-site disposal may be simply transferring the problem to another, less valuable, site. On-site disposal eliminates the costs associated with transportation of the contaminants to other sites, and avoids the potential danger of cross contamination along the transport route. Complete and economically feasible on-site disposal is not readily available, even though cleanup techniques often eliminate contaminants and render land ready for reuse.

Finally, the "how clean is clean?" issue is still very much a problem. Official scientific criteria for cleanliness levels do not exist. Planners therefore are forced to take a pragmatic approach to reclamation efforts. Often initial projects undertaken by governments involve extensive cleanup, but high costs render such policies impossible to follow by developers.

Reclamation programs studied have considered the end-use of the land rather than the contamination level solely to determine the amount of cleanup that is necessary. Until technology is able to offer economic in-situ reclamation techniques, such pragmatic approaches will continue to be used.

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TABLE 1. UNITED STATES CASE STUDIES

Site and Reuse Description	Contamination	Remediation
Bio-Rad Laboratories, CA Reuse: Industrial Park	Numerous deteriorating metal drums and soil contaminated with heavy metals (Pb, Zn, Cu, Cd) and explosives.	Drums removed; contaminated soils excavated.
Hercules Village, CA Reuse: Residential condominiums	Wastewater treatment area contaminated with As, Pb, Cr, Zn, DNT, and DNB.	Soil removed, some residues of DNT and DNB left onsite and covered by clean fill. 2-year monitoring program.
Bayside Village, CA Reuse: Single-family residences and public school	Surface and subsurface soil contained Pb at levels as high as 530 ppm.	All contaminated material removed.
Kellog Terrace, CA Reuse: Residential Condominiums	Contaminated from Pb, As, and aliphatic and aromatic hydrocarbons.	7,034 cu m (9,200 cu yd) of contaminated soil and fill removed.
Kapkowski Road Site, NJ Reuse: Future Industrial Park by the Port Authority of New York and New Jersey	Contamination, from waste oil containing PCBs up to 4,800 ppm. Floating on water table and adhering to meterials in refuse.	Pump out free floating oil from pockets; leave refuse in place. Soils with PCB's greater than 5 ppm to be disposed of as such soil is discovered.

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TABLE 1. (Continued)

Site and Reuse Description	Contamination	Remediation
New York State Electric and Gas Corporation (NYSEG) site Reuse: Recreation Park on the Saranac River	Soil and sediment from the Saranac River contaminated with coal tar leached from unlined coal tar ponds.	Soil-bentonite slurry wall. Contaminated sediment from river bed excavated and removed to containment area surrounded by slurry wall. Containment area capped with Hypalon liner. Cement-bentonite cutoff wall constructed.
Frankford Arsenal Site, PA Reuse: Regional Park and Marina and Light Industrial Development	Low-level radiological contamination in buildings, deposits of explosive/pyrotechnic residues, unexploded ordnance, inorganic chemical residues in buildings and underground waste discharge system.	Explosives residues destroyed. Radiological and heavy metal contamination removed from the site.
The Courtyard, VT Reuse: Housing Project for the Handicapped and Elderly	Solid chemical wastes beneath wood flooring; traces of organic solvents, oil.	Underground tanks emptied; solid inorganic waste & contaminated wood flooring removed. Vapor barrier installed and covered by 4 inches of concrete.

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TABLE 2. EUROPEAN CASE STUDIES

Site and Reuse Description	Contamination	Remediation
Thamesmead, England Reuse: Residential, Amenity	Soil contamination with heavy metals, cyanide, sulfur compounds, coal tar, methane.	Excavation and filling.
Beaumont Leys, England Reuse: Residential Amenity	Heavy metal contamination of soil	Excavation mixing of soils for dilution of contaminants.
Rotterdam Harbor, Sweden Reuse: Residential	Harbor silt contamination with oil	Silt removal or encapsulation
BT Kemi, Sweden Reuse: Buildings	Soil and groundwater contamination with chlorinated phenols, phenoxy acids, DNPB.	Encapsulation, insitu treatment, leaching
Swansea, Wales Reuse: Industry, Amenity	Soil contamination with heavy metals, sulfur coal shale waste.	Revegetation
Treforest, Wales Reuse: Light Industry	Anthrax Spores	Excavation and filling
Brake, West Germany Reuse: Residential	Soil and groundwater contamination with methane, heavy metals, mercury, selenium sulfuric acid, cyanides.	Methane pumped out

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TABLE 2. (Continued)

Site and Reuse Description	Contamination	Remediation
Robert-Muser, W. Germany Reuse: Bakery	Solid tar contamination of soil.	Excavation and filling
Dortmund, W. Germany Reuse: Light Industry, Commerce	Soil contamination with coal tars, volatile organic substances, ferricyanide and sulfur compounds.	Solidification w/water + lignite ash
Kirrweiler, W. Germany Vennigem Reuse: Vineyard	Soil contamination with chlorinated hydrocarbons, paints cyanides, and galvanic residuals.	Excavation
Grenzach-Wyhlem, W. Germany Reuse: Agriculture	Chemical warfare materials, herbicides in soil.	Removal of drums, excavation of soil, incineration
Schwabison-Gmund, W. Germany Reuse: Parking Garage	Groundwater and soil contamination with coal derivatives.	Excavation
Railroad Terminal, Frankfurt, W. Germany Reuse: Government Building	Diesel fuel in soil.	Excavation
Paint Factory, Karlsrule, W. Germany Reuse: None to date	Cyanides in soil, groundwater.	Excavation pumping of groundwater

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TABLE 2. (Continued)

Site and Reuse Description	Contamination	Remediation
U.S. Army Arsenal, Munich, W. Germany Reuse: Commercial Building	Oil in soil, groundwater.	Excavation, filling

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TABLE 3.

FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATIONS (FDER)
"MINIMUM CRITERIA" FOR GROUNDWATER QUALITY

Parameter	FDER Recommended "Minimum Criteria" for Groundwater (mg/L)	Ten Times FDER Recommended "Minimum Criteria" for Groundwater (mg/L)
Arsenic	0.000	0.00
Barium	1.0	10.0
Cadmium	0.01	0.1
Chromium	0.05	0.5
Lead	0.05	0.5
Mercury	0.00014	0.0014
Silver	0.05	0.5
Selenium	0.01	0.1

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